

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	feedforward and "6728324".pn.	USPAT	OR	ON	2006/03/24 21:38
L2	1321	((feedforward (feed adj forward)) same (feedback (feed adj back))) same (filter equalizer)	USPAT	OR	ON	2006/03/24 21:40
L3	5	2 same chip same slic\$4	USPAT	OR	ON	2006/03/24 21:41
L4	21	2 same chip same (slic\$4 decision)	USPAT	OR	ON	2006/03/24 21:56
L5	1	"6690715".pn. and fir	USPAT	OR	ON	2006/03/24 22:00
L6	0	"6690715".pn. and mmse	USPAT	OR	ON	2006/03/24 22:11
L7	1	"6690715".pn. and error	USPAT	OR	ON	2006/03/24 22:02
L8	1	"6690715".pn. and chip	USPAT	OR	ON	2006/03/24 22:02
L9	1	"6678310".pn. and mmse	USPAT	OR	ON	2006/03/24 22:19
L10	1812	375/130.ccls. 375/229.ccls. 375/233.ccls.	USPAT	OR	ON	2006/03/24 22:20
L11	701	chip and 10	USPAT	OR	ON	2006/03/24 22:20
L12	127	fir and 11	USPAT	OR	ON	2006/03/24 22:20
S1	2	"5602583".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:51
S2	2	"5579335".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:54
S3	5	"2003006173".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:54
S4	5	"2003008173".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:55
S5	2	"20030081703".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 10:25
S6	2	"6956564".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 10:25
S7	0	ink and S6	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 10:25

EAST Search History

S8	10578	(feedback (feed adj back)) near2 (filter\$4 equali\$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 11:59
S9	152198	slic\$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 11:59
S10	2205	chip near3 S9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 12:00
S11	19	S8 and S10	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 12:00
S12	0	("2004/0240538").URPN.	USPAT	OR	ON	2006/03/24 17:57
S13	1	"6337878".pn.	USPAT	OR	ON	2006/03/24 17:57
S14	1	chip and S13	USPAT	OR	ON	2006/03/24 21:37

US-PAT-NO: 6728324
DOCUMENT- US 6728324 B1
IDENTIFIER:
TITLE: Method and apparatus for multipath signal
compensation in spread-spectrum communications
systems

Detailed Description Text - DETX (59):

The input signal $u(t)$ represents the output from the carrier recovery circuit 120. The signal $u(t)$ comprises multi-bit complex values (real and imaginary) representing discrete, synchronized samples of the received signal taken at chip or sub-chip resolution. The $u(t)$ samples include multipath interference. The equalizer 130 provides multipath interference cancellation based on applying hard-decision logic to the actual phase value of each input sample of $u(t)$ (chip or sub-chip) to form a sliced sample, or hard-decision value. Preferably, a given input sample is compensated for post-cursor secondary signal interference before hard-slicing, but other embodiments of the equalizer 130 may perform hard slicing before or after pre- or post-cursor compensation. For example, in DSSS using QPSK, or in 802.11b payload data using CCK, each received symbol or chip takes a symbol value on a QPSK constellation, and the hard-decision may be made by hard-slicing the phase of the received sample in $u(t)$. To cancel post-cursor multipath interference, the hard-sliced chip (or sub-chip) decision(s) is fed back with the proper delay(s) (e.g., $\tau_{sub.1i}$) and multiplicand coefficient(s) (e.g., $C_{sub.1i}$) for subtraction from $u(t)$ in summing node 302. This aspect of operation is conceptually similar to more conventional Decision Feedback Equalizers (DFE), which are well understood in the art.

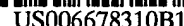
US-PAT-NO: 6678310
DOCUMENT- US 6678310 B1
IDENTIFIER:
TITLE: Wireless local area network spread spectrum
transceiver with multipath mitigation

US Patent No. - PN (1):

6678310

Detailed Description Text - DETX (139):

Decision feedback equalizers are usually trained using either a zero-forcing metric (ZF) or a minimum-mean-squared-error metric (MMSE) as known to those skilled in the art. Most textbooks describe the use of a training sequence with either a slow recursive algorithm (LMS) or a fast recursive algorithm (RLS). Alternatively, for the wireless world, techniques have been developed for instant training using a estimate of the channel impulse response. A preamble (IS-54) or a midamble (GSM) is used with impulsive autocorrelation properties for performing the channel estimation. The channel impulse response can be used to calculate the DFE taps.



(10) **Patent No.:** US 6,678,310 B1
(45) **Date of Patent:** Jan. 13, 2004

- 5,598,154 A 1/1997 Wilson et al. 341/50

(List continued on next page.)

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|----|--------------|---------|------------------|
| EP | 0 755 141 A2 | 2/1997 | H04L/25/03 |
| WO | WO 97/36396 | 10/1997 | H04L7/04 |
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- ## OTHER PUBLICATIONS

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(List continued on next page.)

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- Assistant Examiner—Pankaj Kumar**

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Related U.S. Application Data

- (60) Provisional application No. 60/071,659, filed on Jan. 16, 1998.
- (51) Int. Cl.⁷ H04B 1/69
- (52) U.S. Cl. 375/147
- (58) Field of Search 375/130, 133,
375/135, 136, 137, 140, 141, 142, 144,
150, 219, 224, 229, 230, 232, 233, 295,
316, 329, 346, 349, 147

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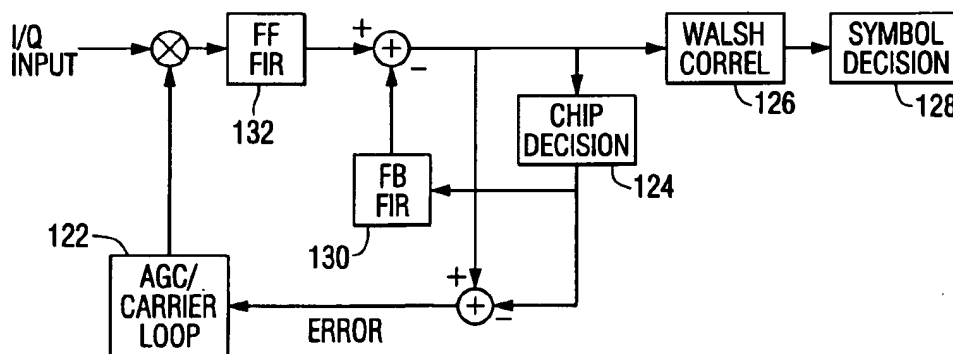
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(57) **ABSTRACT**

A demodulator used in a base band processor of the spread spectrum radio transceiver includes a demodulator circuit for spread spectrum phase shift keying (PSK) demodulating an information signal received from a radio circuit. The information signal includes data symbols formed from a plurality of high rate mode chips forming a spread spectrum information signal. At least one predetermined code function correlator is in line with a signal input for decoding the information signal according to a predetermined code. A carrier loop circuit allows phase and frequency tracking of the information signal and a chip decision circuit is operative with the carrier loop circuit for tracking high rate mode chips. A decision feedback equalizer formed from a feedback finite impulse response filter is operative with the chip decision circuit and the carrier loop circuit. It has a plurality of feedback taps. At least one feedback tap is selected for logical add/subtract operations to aid in canceling multipath signal echoes. A feed forward finite impulse response filter can also be positioned in line to the code function correlator and the signal input and has a plurality of feed forward taps that are selected for logical multiply operations to aid in reducing multipath signal echoes. A method aspect of the invention is also disclosed.

22 Claims, 34 Drawing Sheets



ARCHITECTURE INCLUDING FEEDFORWARD DFE TAPS

US-PAT-NO: 6990158
DOCUMENT- US 6990158 B2
IDENTIFIER:
TITLE: Method and apparatus for multipath signal
compensation in spread-spectrum communications
systems

Description Paragraph - DETX (74):

The input signal $u(t)$ represents the output from the carrier recovery circuit 120. The signal $u(t)$ comprises multi-bit complex values (real and imaginary) representing discrete, synchronized samples of the received signal taken at chip or sub-chip resolution. The $u(t)$ samples include multipath interference. The equalizer 130 provides multipath interference cancellation based on applying hard-decision logic to the actual phase value of each input sample of $u(t)$ (chip or sub-chip) to form a sliced sample, or hard-decision value. Preferably, a given input sample is compensated for post-cursor secondary signal interference before hard-slicing, but other embodiments of the equalizer 130 may perform hard slicing before or after pre- or post-cursor compensation. For example, in DSSS using QPSK, or in 802.11b payload data using CCK, each received symbol or chip takes a symbol value on a QPSK constellation, and the hard-decision may be made by hard-slicing the phase of the received sample in $u(t)$. To cancel post-cursor multipath interference, the hard-sliced chip (or sub-chip) decision(s) is fed back with the proper delay(s) (e.g., $\tau_{sub.1i}$) and multiplicand coefficient(s) (e.g., $C_{sub.1i}$) for subtraction from $u(t)$ in summing node 302. This aspect of operation is conceptually similar to more conventional Decision Feedback Equalizers (DFE), which are well understood in the art.